

Department of Behavioral Sciences and Leadership

West Point Resilience Project (WPRP)

Research Report PL488E12

**Healthy Body and Healthy Mind: A Study of the Relationship between BMI
and Soldier Resilience**

Authors

Alex M. Shoaf

Mark Ziegler

Lolita M. Burrell

Michael D. Matthews

United States Military Academy

April 2011

Approved for public release; distribution is unlimited

Note: The views expressed in this research report do not necessarily reflect the views of the Defense Department, the United States Military Academy, or any other agency of the Federal Government.

HEALTHY BODY AND HEALTHY MIND: A STUDY OF THE RELATIONSHIP BETWEEN BMI AND SOLDIER RESILIENCE

ABSTRACT

The purpose of this project is to evaluate the ability of body mass index (BMI) to predict mental resilience in US Army Soldiers. The hypothesis of this proposed study is that Soldiers with a lower BMI will have a higher mental resilience against stress, and will therefore be less likely to develop PTSD while in combat. Our belief is that BMI will be a significant predictor in comparison to the subjective testing associated with the current Global Assessment Tool (GAT).

HEALTHY BODY AND HEALTHY MIND: A STUDY OF THE RELATIONSHIP BETWEEN BMI AND SOLDIER RESILIENCE

CONTENTS

	Page
INTRODUCTION.....	1
DEPLOYMENT STRESSORS.....	2
RESILIENCE.....	4
FITNESS, RESILIENCE AND HARDINESS.....	6
PROPOSED STUDY METHOD.....	12
Participants.....	12
Apparatus and Procedure.....	12
CONCLUSION.....	12
ANNOTATED REFERENCES.....	13

Introduction

As early as the American Civil War, documented cases have reported Soldiers experiencing memory problems, sleep difficulty, and trouble concentrating because of a recurrence of flashbacks of trauma on the battlefield. During World War I, doctors referred to the condition as “shell shock” and attributed the disorder to the constant artillery fire the Soldiers endured while fighting in the trenches (Carlier and Gersons, 1995). Patients experiencing the same symptoms during World War II were said to be suffering from “gross stress reaction,” and many returning Soldiers from Vietnam were diagnosed with “post-Vietnam syndrome” (Carlier and Gersons, 1995). Posttraumatic Stress Disorder (PTSD) has been documented and criticized throughout every American war, and has become widely accepted as a valid diagnosis throughout the United States military and in the medical field. As technology continues to better the understanding of the causes of PTSD, the mental health community is gaining valuable information to better prevent, diagnose, and treat its effects on the American Soldier both on and off the battlefield. However, it is important to have a firm understanding of past research on PTSD to understand what an individual experiences both physically and mentally when exposed to a traumatic event. Like with any other illness, certain individuals will continue to avoid treatment for PTSD when experiencing its symptoms. It is the responsibility of leaders, friends, coworkers, and family to understand how and why PTSD occurs so that they recognize its symptoms and can help the individuals suffering from it to seek out help.

Posttraumatic stress disorder is an anxiety disorder resulting from an individual’s exposure to a traumatic life threatening event or by an accumulation of stress from intense feelings of fear, helplessness, or horror (Legare, Ryan, & Lewis Herman, 1998). Someone suffering from this disorder has reoccurring flashbacks of the traumatic event, difficulty sleeping,

and often undergoes a series of behavioral changes. They will often suffer from depression, try to isolate themselves from those around them, and experience severe mood swings for no apparent reason. There has been a drastic increase in the number of PTSD cases among Soldiers within the past decade as a result of the Global War on Terrorism that began in 2001. From 2003 to 2007 the number of Soldiers suffering from PTSD increased from 1,020 to 10,049 cases (Sundin, Fear, Iversen, Rona, & Wessely, 2009). This increase in reported cases has the potential to forecast potential problems in the future. As more Soldiers with PTSD are placed in the field, the effects of the disorder will contribute to memory loss and severe mood changes, making the individual ineffective and placing the Soldiers and civilians around the Soldier at risk of sustaining severe injuries.

Deployment Stressors

A variety of factors have contributed to the increase in chronic stress experienced by the individual Soldier. Environmental stressors are major contributors to chronic stress because they cause physiological effects on the body that directly lead to psychological change within an individual's brain. Stimuli include altitude, thermal strain, and inadequate rest. Both Iraq and Afghanistan combine extreme altitude with climates unfamiliar to the American Soldier, making it extremely difficult for Soldiers to adapt. Afghanistan consists of an elevation range between 846 feet and 24,580 feet, which contributes significantly to the country's rigorous seasonal climate. Working at especially high elevations has been known to cause a condition known as hypobaric hypoxia, which reduces the pressure of oxygen within the body and thus reduces a Soldier's physical and cognitive functions because of a deficiency of oxygen within the blood (Askew, 1995). These effects on the body may be countered; however, through a series of incremental physiological changes known as acclimation in order to maintain maximum oxygen

saturation to body tissues. Despite reducing the effects of hypoxia, acclimation takes time and is unable to fully counter its effects. Evolutionary adaptation is the only true way to live in area of excessive high elevation and prolonged exposure has been known to result in lasting neurological damage for individuals unaccustomed to this environment (Fayed, Modrego, & Morales, 2006). Soldiers deployed to Afghanistan and Iraq also face a wide range of climate temperatures that severely restrict efficient work output. Exposures to environments of high temperatures, such as those seen in Iraq, severely limit an individual's ability to conduct operations without risking heat injury due to high water loss and rise in body temperature (Keim, Guisto, & Sullivan, 2002). These environmental stressors are more critical with current operations in the Middle East because the advancements in technology have evolved our military into a highly mobile force, putting today's Soldier at a greater risk of experiencing these stressors.

Soldiers are also faced with psychological factors that can contribute to the development of PTSD. The first Soldiers sent to Iraq and Afghanistan were trained using conventional means and tactics. Although adequately trained to face a professional enemy force, American forces instead faced an unconventional enemy that could blend with the general population and used ground-emplaced and vehicle-borne IEDs (VBIEDs) to inflict mass casualties. With no way to detect, identify, and avoid these devices during the early years of the war, studies demonstrated that the threat of falling victim to such an attack placed every Soldier under a massive degree of constant chronic stress (Stuart, Ursano, Fullerton, Norwood & Murray, 2003). A sustained level of high chronic stress can affect an individual by causing changes in emotional, physiological, and behavioral responses. While these physiological and psychological factors may contribute

to/exacerbate PTSD symptomatology, there are Soldiers who experience the same amount of trauma yet they do not develop PTSD related symptoms.

Resilience

Medical professionals are currently reviewing why certain individuals have a “resilience” to PTSD when compared to others who develop the disorder under the same circumstances in order to establish a better understanding of its development and prevention. One particular characteristic noticed within the military is that most individuals who do not suffer from PTSD show signs of having a relatively high physical fitness level when compared to those suffering from PTSD. In one particular study comparing APFT scores to the impacts of simulated stressful events, resilient individuals (or those less affected by the simulated stress) displayed higher scores in aerobic fitness by having a significantly faster two-mile run time when compared to others more affected by stress (Taylor, Markham, & Reis, 2008). Exercising on a regular basis has shown to directly deter distress through its positive association with psychological resources such as self-esteem and confidence (Ensel & Lin, 2003). This could be due to the physiological benefits the body gains from physical fitness such as better oxygen intake, more efficient respiration rates, and increase in blood flow to the vital organs including the brain. These benefits in return result in neurochemical adaptations to acute stress from exercising which leads to an increase in resilience to all forms of stress (Salmon, 2001). Changes in several neurotransmitters systems have been attributed to behavioral adaptation while noradrenergic and opioid effects of exercise have been theorized to explain mood improvements. Future research on the correlation between exercise and psychological improvements in mood, confidence, and sense of well-being will provide new opportunities to develop effective physiological methods to preventing and treating PTSD.

Another critical aspect in the prevention of PTSD among Soldiers is their personal attitude towards the world around them. Research has found that people who are socially isolated and have little confidence are more prone to experience depression and anxiety over time, often developing signs of worthlessness when faced with a difficult traumatic event. More resilient individuals tend to face reality with the intent of finding meaning with life, thus allowing individuals to push the limits of human endurance. By viewing difficult events as positive challenges, individuals are able to establish a psychological “hardiness” trait within themselves which allow them to survive utterly hopeless situations (Maddi, 1999). A study conducted on Special Forces candidates that assessed their commitment to life and work found hardiness to be a significant predictor of success in graduating the course when compared to Soldiers of the same military experience and training who did not complete the course (Bartone, Roland, Picano, & Williams, 2008). Maintaining a positive attitude is imperative for an individual within the military because it has the ability to promote problem-solving solutions to complex problems among the unit.

One research direction designed to understand resilience to PTSD entails assessing individuals’ positive reactions when faced with a traumatic event. This approach on assessing the benefits of a traumatic event is called posttraumatic growth (PTG) and it relates to the positive psychological changes experienced as a result of challenging life circumstances (Hobfoll & Hall, 2007). A study with 272 veterans from Operation Enduring Freedom and Operation Iraqi Freedom found that Soldiers who were reinforced with positive conditioning from military leadership and through humanitarian operations found positive outcomes from their deployments. Specifically, 52.2% developed changing priorities about what is important in life and 48.5% reported a better handling of difficulties (Pietrzak, Goldstein, Malley, & Rivers,

2010). Additionally, those who believed in positive outcomes as a result of their deployment experienced a reduction in PTSD related symptoms such as mood changes and sleep disturbances. This evidence of PTG benefits coincides with prolonged studies on PTSD cases among American prisoners of war (POW) during Vietnam. Despite the chronic stress experienced as a prisoner, those who did not suffer from PTSD after being released claimed the event made them stronger and allowed them to establish a strong relationship with fellow Soldiers (Feder, Southwick, Goetz, & Wang, 2008).

Fitness, Resilience and Hardiness

The idea of a mind-body connection has existed since Plato, and various studies demonstrate that there is a strong connection between physical health and mental health in an individual, especially mental health in the realm of psychological hardiness and resilience to stress. A healthy body is best interpreted as physically fit, but this general term may be translated in different ways. Weight lifters are physically fit, as are marathoners, and as are soccer players; however, the Army's standard for physical fitness includes passing the Army Physical Fitness Test (APFT), which consists of 2 minutes of pushups, 2 minutes of sit-ups, and a 2 mile run for time. Every Soldier must pass the APFT semiannually to be deemed fit for duty. Along with the APFT, the Army also requires Soldiers to meet height and weight standards for their age brackets. This height and weight data allows the Army to calculate a Soldier's body mass index (BMI), and provides a means to assess physical fitness by calculating the body's fat percentage.

Deurenberg et al. (1991) researched the validity of BMI as a successful predictor of body fat percentage (BF%). BMI, or Quetelet's Index, is defined as $\text{body-weight/height}^2$. This equation proves to have a high correlation to BF%, but a low correlation to height. When using BMI as a measure of BF%, it is important to take into account a subject's age and sex, as these

factors have a significant effect on the subject's body composition. Deurenberg et al. (1991) found that BMI was a successful predictor of what the observed BF% (when measured by immersion technique) would be within a confidence interval of 95%. From the age of 7, BMI, with consideration of age and sex, was a successful measure of BF%. However, it is important to note that BMI accuracy decreases significantly for adolescent children. The prediction error in the estimated BF% using BMI as the formula is approximately 3-5%, which is roughly the same prediction error for skin fold thickness formulas as well as the bioelectrical impedance technique.

Nielsen & Andersen (2003) studied the relationship between fitness as measured by a shuttle run test, and BMI with blood pressure (BP). The study used 13,557 subjects, male and female, between the ages of 15 and 20. The study found that both BMI and fitness were independently associated with BP, specifically a high BMI and low fitness level was associated with increased BP. Additionally, females with low fitness levels were more likely to be hypertensive if they also had a high BMI.

Given the positive relationship between BMI and physical fitness, it is important to understand why physical fitness should be considered a good tool to physiologically assess psychological hardiness. Dienstbier et al. (1981) conducted a study that addresses this point. Their hypothesis was that regular aerobic exercise leads to a chronic reduction in the individual's experienced stress responses to psychological stressors. They used 30 volunteers who signed up to train to run a marathon. Of the 30 volunteers, 23 completed the course and 5 were females. Initially, they split the participants into three groups based on self-assessment. They were classified as: non-runners, short runners, and marathon runners. The researchers later realized that another key factor was the participants' commitment to running and thus split these groups further into: high running self-concept (RSC), moderate RSC, and low RSC. They would subject

these runners to both subjective and objective testing prior to, during, and after all of their training runs. The results suggest that across both physiological and psychological dependent measures that moderate running did positively influence tolerance to stress.

Dolan et al. (2005) found evidence that suggests a link between length of work days, which are assumed to cause stress, exercise and suppression of the negative emotions associated with depression. Dolan's study involved surveys that were administered to 1,422 U.S. Army, Europe Soldiers. The surveys focused on the effects of operations tempo and how it affected a Soldier's perceived stress symptoms. Two surveys administered were the Center for Epidemiological Studies-Depression Scale (CES-D) and the General Health Questionnaire (GHQ) which is used to indicate distress. With regard to CES-D scores, physical exercise by itself was statistically insignificant, but significantly interacted with length of work days. This suggests that exercise buffers the stress associated with perceived workload thus reducing depressive symptoms that may be associated with PTSD. These findings were corroborated by Johnston et al's. (2004) study where BMI was significantly associated with CES-D scores. The GHQ was significantly correlated with exercise and scores were also predicted by an exercise and work interaction. This study agrees with data analyzed by Pomaki (2007) that suggests health promoting behavior such as maintaining a healthy BMI, can decrease depressive symptoms. Since physical exercise is linked to physical fitness which in part, is measured by BMI, BMI could be used to indicate psychological distress. Bartone (2009) found similar data when comparing high density lipoprotein (HDL) and hardiness. HDL was positively correlated with hardiness while BMI had a negative correlation.

The stress hormone, cortisol, is used by the body to mediate the impact of stress. Cortisol is known to have an adverse effect on cognitive performance and cortisol is independently

increased by acute stress and body fat. Mujica-Parodi (2009) found that body fat was significantly correlated with reactivity to cortisol and state anxiety when under stressful activity. This could be the biological connection between physical fitness and reactions to acute stress and may be modeled with body fat which can be gathered by collecting height and weight data for BMI.

Another study examining the psychological effects of exercise analyzed the perceived stress levels of collegiate athletes against students that did not participate in athletics and exercised no more than twice a week. Skirka's study (2000) found that athletes had a statistically significant difference in hardiness, daily hassles, and profile of mood states than their non-athletic counterparts. Hardiness was determined by an interval scale developed to measure the character trait which includes a sense of control, commitment, and perception. The Daily Hassles scale was developed to measure stress levels from daily irritants and minor annoyances. The Profile of Mood States (POMS) scale consists of 65 adjectives that are rated from 0-4. The higher the POMS score the greater the psychological distress. This study found an inverse relationship between physical activity and perceived stress level. A study by Rejeski (1992) also found that aerobic exercise had an inverse correlation to stress reaction and anxiety in adult women.

Similarly, Taylor et al. (2004) studied physical activity effects on psychological conditions based on the Healthy People 2010 guidelines. Participants were divided into one of three groups: 1) met the recommendation, 2) exercised, but did not meet the recommendation, or 3) were inactive. The study found that inactivity was related to being 1.31 times more likely to have at least 14 days of mental distress in the past 30 days.

Several studies have examined the effects of stress and fitness on resiliency to illness. Brown & Siegel (1988) found that those with a lower fitness level reacted to stress in a negative manner represented as an illness score. Brown (1991) also found that physical fitness had an effect on medical visits. Brown studied both objective and subjective measures of physical fitness and stress. When physical fitness was used as a variable to determine health care visits there were main effects for stress and fitness as well as a fitness stress interaction. In this study, individuals under highly stressful daily activities that demonstrated high physical fitness were shown to visit medical facilities less. This suggests a buffering effect created by physical fitness that deters the negative effects of stress that are associated with illness.

MAJ Leth (2009), a former Department of Physical Education instructor at the United States Military Academy, is studying the benefits that physical fitness has on resilience to PTSD and the issue with the Army's current physical fitness policy that allows for physical complacency, which can lead to a decrease in mental hardiness. MAJ Leth points out that cohesion, leadership, and training all affect a Soldier's mental health and hardiness and argues that unit cohesion is successfully created and maintained most effectively through unit physical training which engages the whole person. The training that MAJ Leth focuses on in his study is physical training associated with affecting the whole Soldier; mind, body, and spirit. The final variable discussed was leadership and a leaders' role in facilitating cohesion and training which may promote hardiness and resilience.

The use of BMI and perceived fitness level, as a metric for psychological resilience, was examined in Swiss police by Gerber et al (2010). Gerber found that perceived fitness had a direct correlation with perceived stress level of police and other emergency response professionals. This begs the question of the whether physical fitness as, measured by variables such as VO_2

Max and muscle strength or fitness measured by BMI and body fat% is more important in determining resilience to stress and anxiety.

Physical fitness as a measure of stress resilience was studied by Taylor, et al. (2008) by examining stress levels in Survival, Evasion, Resistance, Escape (SERE) school students prior to and post training. A total of 31 male participants provided their most recent physical fitness test score and completed the Spielberger State-Trait Anxiety Inventory. Within 24 hours after their SERE training was complete, the participants were administered the Impact of Events Scale-Revised (IES-R). The IES-R total score was then tested for a relationship with the various physical fitness data. Each individual physical fitness test event score had a significant relationship to the total IES-R score with p-values of 0.05 or less, but the most statistically significant effect came from the 1.5 mile run times with a p-value of 0.008. In this study, BMI alone was found statistically insignificant with a p-value of 0.7, but this may be due to the small sample size or the fact that only select Soldiers in peak physical condition are sent to SERE. However, there was a significant interaction between run time and BMI. This study shows the impact that physical fitness can have on mental hardiness in extremely stressful military situations, but may not generalize to all Soldiers.

Proposed Study Method

Participants

Participants will include every Soldier that completes the Global Assessment Tool (GAT).

Apparatus and Procedure

The next step is to examine the relationship between physical fitness scores, height, weight and Soldiers' GAT scores. The most efficient means is to use the data that the Army already collects on height, weight and fitness scores. This method of data collection is free and is relatively fast and easy. However, data on height, weight and physical fitness are handwritten and likely not entered into an electronic database. However, if the data are entered electronically, the information is not part of a global system.

In addition, to examining the relationship to GAT scores, BMI should also be tested to see if there is a relationship with Article 15 and promotion rates as these are other measures being analyzed with the Comprehensive Soldier Fitness (CSF) program that may indirectly reflect a lack of resilience to deployment-related stress.

Conclusion

In summary, BMI may be a good way to start examining resilience, because it is a partial measure of physical fitness for which the Army already collects data and that is correlated with well-being. This makes BMI, as a metric for resilience, an extremely cost and time efficient tool. Additionally, BMI, to a degree, is controllable and thus may be used as a preventive fitness measure or as a treatment tool to reduce stress and anxiety. Of course, changes in BMI will be due to lifestyle changes that include diet and exercise, thus further illustrating the complex relationship between BMI and resilience.

Annotated References

Askew, E. W. (1995). Environmental and physical stress and nutrient requirements. *The American Journal of Clinical Nutrition*, 61.3S, 631-637.

This article explained how environmental factors can contribute to various levels of stress and difference in nutrition requirements the body goes through to adapt. It also provided insight on how altitude changes can influence PTSD among Soldiers.

Bartone, P. T., Roland, R. R., Picano, J. J., & Williams, T. J. (2008). Psychological hardiness predicts success in U.S. Army Special Forces candidates. *International Journal of Selection and Assessment*, 16(1), 78-81.

This article provided evidence on the relation of physical fitness to resilience towards stress. The study found that Special Forces candidates who scored higher physically on their APFT were more likely to succeed in the challenges presented to them and complete SF selection.

Bartone, P., Spinosa, T., & Robb, J. (2009). *Psychological hardiness is related to baseline high-density lipoprotein (HDL) cholesterol levels*. Washington, D.C.: National Defense University.

This study examines psychological hardiness and cholesterol in healthy adults working in demanding national security occupations. The results show that psychological hardiness is associated with increased levels of high-density cholesterol, suggesting a psychological resilience process that may be especially salient for cardiovascular health outcomes.

Brown, J. (1991). Staying fit and staying well: Physical fitness as a moderator of life stress. *Journal of Personality and Social Psychology*, 60(4), 555-561.

This study examined links between stress and physical fitness with 110 undergraduates. The researchers tested the stress-buffering effect of fitness with subjective and objective indicators of exercise, fitness, and physical well-being. For self-reports of health, both self-reports of exercise and objective measures of fitness showed the buffering effect.

Brown, J., & Siegel, J. (1988). Exercise as a buffer of life stress: A prospective study of adolescent health. *Health Psychology*, 7(4), 341-353.

This study examined the links between physical activity, stress, and illness in adolescent females through subjective testing with self-reported values. Their findings suggest that exercise could be a resource in combating life stress.

Carlier, I., & Gersons, B. (1995). Partial posttraumatic stress disorder: The issue of psychological scars and the occurrence of PTSD Symptoms. *The Journal of Nervous and Mental Disease*, 183(2), 107-108.

This article provided information on the history of PTSD from its documented cases reported during World War I and World War II. It provides evidence on how PTSD has always been within the military and the importance of treating it.

Deurenberg, P., Weststrate, J., & Seidell, J. (1991). Body mass index as a measure of body fatness: Age- and sex- specific prediction formulas. *British Journal of Nutrition*, 65, 105-114.

This study was used to suggest that BMI is an accurate measure of body fat %.

Dienstbier, R., Crabbe, J., Johnson, G., Thorland, W., Jorgensen, J., Sadar, M., et al. (1981). Exercise and stress tolerance. *Psychology of Running*, 192-210.

This chapter suggests a link between aerobic exercise and psychological effects. The research shows a correlation between running condition and anxiety and mental fatigue.

Dolan, C. A., Adler, A. B., Thomas, J. L., & Castro, C. A. (2005). Operations tempo and Soldier health: The moderating effect of wellness behavior. *Military Psychology*, 17(3), 157-174.

This study examines how exercise can moderate the impact of work hours on perceived stress and health. They found that exercise successfully moderated both psychological and physical health decline due to work hours.

Ensel, W. M., & Lin, N. (2003). Physical fitness and the stress process. *Journal of Community Psychology*, 32(1), 81-101.

The article discusses how conducting physical fitness exercises can reduce the amount of stress an individual experiences by promoting self-esteem and positive attitudes. It supports the claim that physical fitness and resilience to stress are related.

Fayed, N., Modrego, P. J., & Morales, H. (2006). Evidence of brain damage after high-altitude climbing by means of magnetic resonance imaging. *American Journal of Medicine*, 119, 168e1-168e6.

This article documented cases in which prolonged exposure to high altitudes caused permanent neurological damage to mountaineers. The findings provided evidence that extreme environments are associated with stress and may influence cognitive functions.

Feder, A., Southwick, S., Goetz, R. R., & Wang, Y. (2008). Posttraumatic growth in former Vietnam prisoners of war. *Psychiatry: Interpersonal & Biological Processes*, 71(4), 359-370.

This article shows how Vietnam veterans who claimed positive outcomes from being prisoners of war experienced low levels of PTSD when compared to Soldiers who reacted negatively to their experiences. This article indicates that good leadership can promote resilience and reduce the stress caused by traumatic events.

Gerber, M., Kellmann, M., Hartmann, T., & Puhse, U. (2010). Do exercise and fitness buffer against stress among Swiss police and emergency response service officers? *Psychology of Sport and Exercise*, 37, 1-9.

This study examined how exercise and physical fitness affects stress in emergency response units and police. They reported that exercise did not have a significant effect, but physical fitness did correlate to reduced stress levels.

Hobfoll, S. E., & Hall, B. J. (2007). Refining our understanding of traumatic growth in the face of terrorism: Moving from meaning cognitions to doing what is meaningful. *Applied Psychology: An International Review*, 56(3), 345-366.

Another article showing the importance of posttraumatic growth among Soldiers. Again, Soldiers who reacted to traumatic events in a positive manner and believed in an overall purpose in their deployment showed a significant reduction in PTSD related symptoms when compared to Soldiers who reacted negatively to their experiences.

Johnston, E., Johnston, S., McLeod, P., & Johnston, M. (2004). The relation of body mass index to depressive symptoms. *Canadian Journal of Public Health*, 95(3), 179-183.

This study used the CES-D scale to assess the relationship between obesity, as determined by BMI, and depression. They found that an obese individual is 1.41 times more likely to have symptoms of depression than a healthy individual.

Keim, S. M., Guisto, J. A., & Sullivan, J. B. (2002). *Environmental thermal stress*. Tucson, Arizona: Department of Emergency Medicine.

This article outlines the environmental stressors a person faces due to thermal constraints. In particular, it addressed the physiological changes the body goes through in reaction to extreme high and low temperatures.

Legare, G., Ryan, R., & Lewis Herman, J. (1998). *Diagnostic and statistical manual of mental disorders (DSM-IV)*. Arlington, VA: American Psychiatric Association.

This manual defines PTSD as well as the causes and symptoms of the disorder in accordance with the American Psychiatric Association guidelines.

Leth, A. D. (2009). *The relationship between post traumatic stress and physical fitness and the impact of Army fitness policy on post traumatic stress prevention*. Fort Leavenworth, Kansas: Command and General Staff College.

This report outlines the effects of the increase in OPTEMPO on stress and its relationship to a decrease in physical fitness training across the Army. It suggests a change to the current physical training program focus in order to decrease anxiety and stress among Soldiers.

Maddi, S. R. (1999). The personality construct of hardiness: Effects on experiencing, coping, and strain. *Consulting Psychology Journal*, 51(2), 83-94.

This article gave the definition and characteristics of hardiness and how it applies to resilience to stress.

Mujica-Parodi, L., Renelique, R., & Taylor, M. (2009). Higher body fat percentage is associated with increased cortisol reactivity and impaired cognitive resilience in response to acute emotional stress. *International Journal of Obesity*, 33(1), 157-165.

This study analyzes the relationship between increased emotional stress and high BMI. The findings indicate that an increased level of cortisol in the body can increase stress and decrease cognitive ability.

Nielsen, P. G., & Andersen, P. L. (2003). The association between high blood pressure, physical fitness, and body mass index in adolescents. *Preventive Medicine*, 36(2), 229-234.

This article outlines the connection between BMI and physical fitness. The researchers used blood pressure to determine physically fit individuals and found that BMI had a high correlation to hypertension, which would indicate poor physical fitness.

Pietrzak, R. H., Goldstein, M. B., Malley, J. C., & Rivers, A. J. (2010). Posttraumatic growth in veterans of Operations Enduring Freedom and Iraqi Freedom. *Journal of Affective Disorders*, 126(1-2), 1-6.

The article explains the possible reasons why PTG increases an individual's resilience to stress experienced during combat.

Pomaki, G., Supelli, A., & Verhoeven, C. (2007). Role conflict and health behaviors: Moderating effects on psychological distress and somatic complaints. *Psychology and Health*, 22(3), 317-335.

This study examined the moderating roles of health promoting behaviors on depressive symptoms and emotional exhaustion. Moderating effects included exercise and BMI, but they were not independent predictors of outcomes.

Rejeski, W. J., Thompson, A., Brubaker, P., & Miller, H. (1992). Acute exercise: Buffering psychosocial stress responses in women. *Health Psychology, 11*(6), 355-362.

This study examined the effects of acute exercise on psychological stress and attention. They found that exercise dampened blood pressure reactivity to psychological stress. This suggests that exercise can be used to moderate stress.

Salmon, P. (2001). Effects of physical exercise on anxiety, depression, and sensitivity to stress: A unifying theory. *Clinical Psychology Review, 21*(1), 33-61.

This article provided evidence related to the psychological changes a person experiences when faced with stress and why there has been an increase in PTSD cases among Soldier's within the past decade.

Skirka, N. (2000). The Relationship of hardiness, sense of coherence, sports participation, and gender to perceived stress and psychological symptoms among college students. *Journal of Sports Medicine and Physical Fitness, 40*(1), 63-70.

This study examined college athletes versus non-athletes and how they reacted to daily stress. They found that, when controlling for gender, athletes had significantly higher hardiness scores.

Stuart, J. S., Ursano, R. U., Fullerton, C. S., Norwood, A. E., & Murray, K. (2003). Belief in exposure to terrorist agents: Reported exposure to nerve or mustard gas by Gulf War veterans. *Journal of Nervous and Mental Disease, 191*(7), 431-436.

This article provided evidence regarding the psychological changes a person experiences when faced with stress and why there has been an increase in PTSD cases among Soldier's within the past decade.

Sundin, J., Fear, N. T., Iversen, A., Rona, R. J., & Wessely, S. (2009). PTSD after deployment to Iraq: Conflicting rates, conflicting claims. *Psychological Medicine, 40*(3), 367-382.

This article shows the importance of better understanding what PTSD is and why it should be a priority amongst the military. It goes into detail on the reasons why the number of PTSD related cases among military servicemen and women has exploded within the past decade.

Taylor, M., Markham, A., Reis, J., Padilla, G., Potterat, E., Drummond, S., et al. (2008). Physical fitness influences stress reactions to extreme military training. *Military Medicine*, 173(8), 738-742.

This study examined the effect of physical fitness in SERE school students and their perceived stress from the school. They found that run time with BMI had a significant effect on perceived stress and could be used as a buffer to stress.

Taylor, M., Pietrobon, R., Pan, D., Huff, M., & Higgins, L. (2004). Healthy People 2010 physical activity guidelines and psychological symptoms: Evidence from a large nationwide database. *Journal of Physical Activity & Health*, 1(2)114-130.

This study examined how physical activity could affect psychological symptoms. They found that individuals who did not exercise were more likely to demonstrate symptoms of depression and anxiety.